

TOXICOLOGICAL PROFILE FOR
BARIUM AND COMPOUNDS

Agency for Toxic Substances and Disease Registry
U.S. Public Health Service

July 1992

DISCLAIMER

The use of company or product name(s) is for identification only and
does not imply endorsement by the Agency for Toxic Substances and Disease Registry.

Foreword

Each toxicological profile begins with a public health statement, which describes in nontechnical language a substance's relevant toxicological properties. Following the public health statement is information concerning levels of significant human exposure and, where known, significant health effects. The adequacy of information to determine a substance's health effects is described in a health effects summary. Data needs that are of significance to protection of public health will be identified by ATSDR, the National Toxicology Program (NTP) of the Public Health Service, and EPA. The focus of the profiles is on health and toxicological information; therefore, we have included this information in the beginning of the document.

The principal audiences for the toxicological profiles are health professionals at the federal, state, and local levels, interested private sector organizations and groups, and members of the public.

This profile reflects our assessment of all relevant toxicological testing and information that has been peer reviewed. It has been reviewed by scientists from ATSDR, the Centers for Disease Control, the NTP, and other federal agencies. It has also been reviewed by a panel of nongovernment peer reviewers. Final responsibility for the contents and views expressed in this toxicological profile resides with ATSDR.

A handwritten signature in black ink that reads "William L. Roper". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

William L. Roper, M.D., M.P.H.
Administrator
Agency for Toxic Substances and
Disease Registry

CONTENTS

FOREWORD	iii
LIST OF FIGURES	ix
LIST OF TABLES	xi
1. PUBLIC HEALTH STATEMENT	1
1.1 WHAT IS BARIUM?	1
1.2 HOW MIGHT I BE EXPOSED TO BARIUM?	2
1.3 HOW CAN BARIUM ENTER AND LEAVE MY BODY?	3
1.4 HOW CAN BARIUM AFFECT MY HEALTH?	3
1.5 IS THERE A MEDICAL TEST TO DETERMINE WHETHER I HAVE BEEN EXPOSED TO BARIUM?	4
1.6 WHAT RECOMMENDATIONS HAS THE FEDERAL GOVERNMENT MADE TO PROTECT HUMAN HEALTH?	4
1.7 WHERE CAN I GET MORE INFORMATION?	5
2. HEALTH EFFECTS	7
2.1 INTRODUCTION	7
2.2 DISCUSSION OF HEALTH EFFECTS BY ROUTE OF EXPOSURE	7
2.2.1 Inhalation Exposure	8
2.2.1.1 Death	9
2.2.1.2 Systemic Effects	9
2.2.1.3 Immunological Effects	10
2.2.1.4 Neurological Effects	10
2.2.1.5 Developmental Effects	11
2.2.1.6 Reproductive Effects	11
2.2.1.7 Genotoxic Effects	11
2.2.1.8 Cancer	11
2.2.2 Oral Exposure	12
2.2.2.1 Death	12
2.2.2.2 Systemic Effects	13
2.2.2.3 Immunological Effects	26
2.2.2.4 Neurological Effects	26
2.2.2.5 Developmental Effects	27
2.2.2.6 Reproductive Effects	27
2.2.2.7 Genotoxic Effects	28
2.2.2.8 Cancer	28
2.2.3 Dermal Exposure	28
2.2.3.1 Death	29
2.2.3.2 Systemic Effects	29
2.2.3.3 Immunological Effects	30
2.2.3.4 Neurological Effects	30
2.2.3.5 Developmental Effects	30
2.2.3.6 Reproductive Effects	30
2.2.3.7 Genotoxic Effects	30
2.2.3.8 Cancer	30

2.3	TOXICOKINETICS	31
2.3.1	Absorption	31
2.3.1.1	Inhalation Exposure	31
2.3.1.2	Oral Exposure	31
2.3.1.3	Dermal Exposure	32
2.3.2	Distribution	32
2.3.2.1	Inhalation Exposure	32
2.3.2.2	Oral Exposure	32
2.3.2.3	Dermal Exposure	33
2.3.3	Metabolism	33
2.3.4	Excretion	33
2.3.4.1	Inhalation Exposure	33
2.3.4.2	Oral Exposure	33
2.3.4.3	Dermal Exposure	33
2.3.4.4	Other Routes of Exposure	33
2.4	RELEVANCE TO PUBLIC HEALTH	34
2.5	BIOMARKERS OF EXPOSURE AND EFFECT	44
2.5.1	Biomarkers Used to Identify and/or Quantify Exposure to Barium	45
2.5.2	Biomarkers Used to Characterize Effects Caused by Barium	46
2.6	INTERACTIONS WITH OTHER CHEMICALS	46
2.7	POPULATIONS THAT ARE UNUSUALLY SUSCEPTIBLE	47
2.8	MITIGATION OF EFFECTS	48
2.9	ADEQUACY OF THE DATABASE	49
2.9.1	Existing Information on Health Effects of Barium	49
2.9.2	Data Needs	51
2.9.3	On-going Studies	58
3.	CHEMICAL AND PHYSICAL INFORMATION	59
3.1	CHEMICAL IDENTITY	59
3.2	PHYSICAL AND CHEMICAL PROPERTIES	59
4.	PRODUCTION, IMPORT, USE, AND DISPOSAL	67
4.1	PRODUCTION	67
4.2	IMPORT/EXPORT	67
4.3	USE	67
4.4	DISPOSAL	71
5.	POTENTIAL FOR HUMAN EXPOSURE	73
5.1	OVERVIEW	73
5.2	RELEASES TO THE ENVIRONMENT	73
5.2.1	Air	75
5.2.2	Water	78
5.2.3	Soil	79
5.3	ENVIRONMENTAL FATE	79
5.3.1	Transport and Partitioning	79
5.3.2	Transformation and Degradation	80
5.3.2.1	Air	80
5.3.2.2	Water	81
5.3.2.3	Soil	81
5.4	LEVELS MONITORED OR ESTIMATED IN THE ENVIRONMENT	82

5.4.1	Air	82
5.4.2	Water	82
5.4.3	Soil	83
5.4.4	Other Environmental Media	83
5.5	GENERAL POPULATION AND OCCUPATIONAL EXPOSURE	84
5.6	POPULATIONS WITH POTENTIALLY HIGH EXPOSURES	86
5.7	ADEQUACY OF THE DATABASE	86
5.7.1	Data Needs	87
5.7.2	On-going Studies	89
6.	ANALYTICAL METHODS	91
6.1	BIOLOGICAL MATERIALS	91
6.2	ENVIRONMENTAL SAMPLES	93
6.3	ADEQUACY OF THE DATABASE	96
6.3.1	Data Needs	96
6.3.2	On-going Studies	97
7.	REGULATIONS AND ADVISORIES	99
8.	REFERENCES	105
9.	GLOSSARY	135
APPENDICES		
A.	USER'S GUIDE	A-1
B.	ACRONYMS, ABBREVIATIONS, AND SYMBOLS	B-1
C.	PEER REVIEW	C-1

LIST OF FIGURES

2-1	Levels of Significant Exposure to Barium - Oral	18
2-2	Existing Information on Health Effects of Barium	50
5-1	Frequency of NPL Sites with Barium Contamination	74

LIST OF TABLES

2-1	Levels of Significant Exposure to Barium - Oral	14
3-1	Chemical Identity of Barium and Compounds	60
3-2	Physical and Chemical Properties of Barium and Compounds	63
4-1	Facilities That Manufacture or Process Barium and Compounds	68
5-1	Releases to the Environment from Facilities That Manufacture or Process Barium and Compounds	76
6-1	Analytical Methods for Determining Barium in Biological Materials	92
6-2	Analytical Methods for Determining Barium in Environmental Samples	94
7-1	Regulations and Guidelines Applicable to Barium	100

